ANALYSIS AND DESIGN OF AUDITORIUM USING STAAD.Pro

M. S. BANGAR[1] U.R. KAWADE[2]
[1]*PG Research Scholar Dr. V.V.P. College of Engineering, Ahmednagar, 414111, India*
[2]*Associate Professor Dr. V.V.P. College of Engineering, Ahmednagar, 414111, India*
Email: muktabangar007@gmail.com

ABSTRACT

This project involves planning, analysis and design of RCC building of Steel roof. The capacity of auditorium is 1000 persons. The proposed structure is G+1 building with parking floor. The analysis and design involves structural planning, load calculations, analysis using 3D modelling software STAAD-Pro v8i, design of R.C.C. columns, beams, steel roof i.e. steel columns, beams, purlins. We are also designing this structure in SCIA ENGINEER software. SCIA is multi material structural analysis software and design tool for all types of structures.
The complicated structures required more time for calculations using conventional manual methods. STAAD-Pro and SCIA provide us fast and accurate platform for design. In this project we are designing and analysing the project manually. Software gives safer and most accurate results.
Keywords: *Auditorium, STAAD Pro, Design, RCC, Steel, SCIA ENGINEER.*

1. INTRODUCTION

Now a days, due to rapid increase in infrastructural development, construction of buildings also increases. Conventional method of manual design of building is time consuming as well as possibility of human errors. So, it is necessary to use some computer based software which gives more accurate results and reduce the time requires for design.

STAAD-PRO is the structural software is nowadays accepted by structural engineers which can solve typical problem like static analysis, wind analysis, seismic analysis using various load combination to confirms various codes such as IS 456:2000, 1893:2002, IS 875:1987 etc. STAAD Pro is structural engineering software that addresses all aspects of structural engineering including model development, verification, analysis, design and review of results. STAAD. Pro has following advantages:

- Easy to use interface,
- Conformation with the Indian Standard Codes,
- Versatile nature of solving any type of problem,
- Accuracy in design

SCIA engineer has wide range of functionality makes it ideal for any type of building within same easy to use environment. In traditional software tools there is need to work with single node and finite elements, SCIA can define members with just one click. SCIA has productive environment and its wide applicability, it will provide you several benefits:

- Fast and efficient modelling
- Advanced analysis
- Multi-material design
- Coordinated documentation and reporting
- Interoperability and collaboration

1.1Aim of Project

- Understanding of design and detailing concept.
- Learning of STADD Pro. And SCIA ENGINEER software package.
- Approach for Professional practice in field of Structural Engineering.

1.2 Objective

- Analysis and Design the structure.

2. LITERATURE REVIEW

[1] Manoj Nallanathel et al., (2018)

The project include design and analysis of auditorium to accommodate 900 persons. The dimensions of auditorium building 55mX22m. This includes planning, analysis of loads, and designing of structural elements based on the loads coming on them.

[2] M. Siva Naga Kanya et al., (2017)

The project include design and analysis of multi-storied G+5 building. The main objective of this project is to analysis and design a multi storied building by using STADD Pro. The design involves load calculations manually and analysis whole structure by STADD Pro.

[3] Aman et al, (2016)

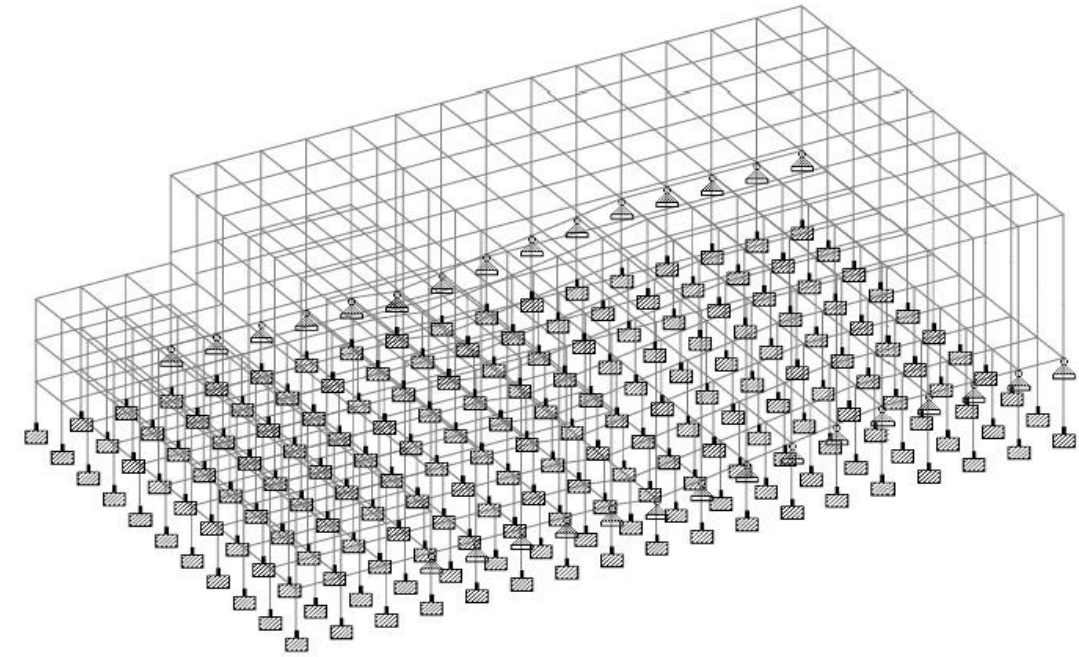
The project include design and analysis of multi- storied building by STADD Pro. This project belongs to the unity builders to be executed in the Gulbarga City. The name of the project is Bharat pride.

3. METHODOLOGY

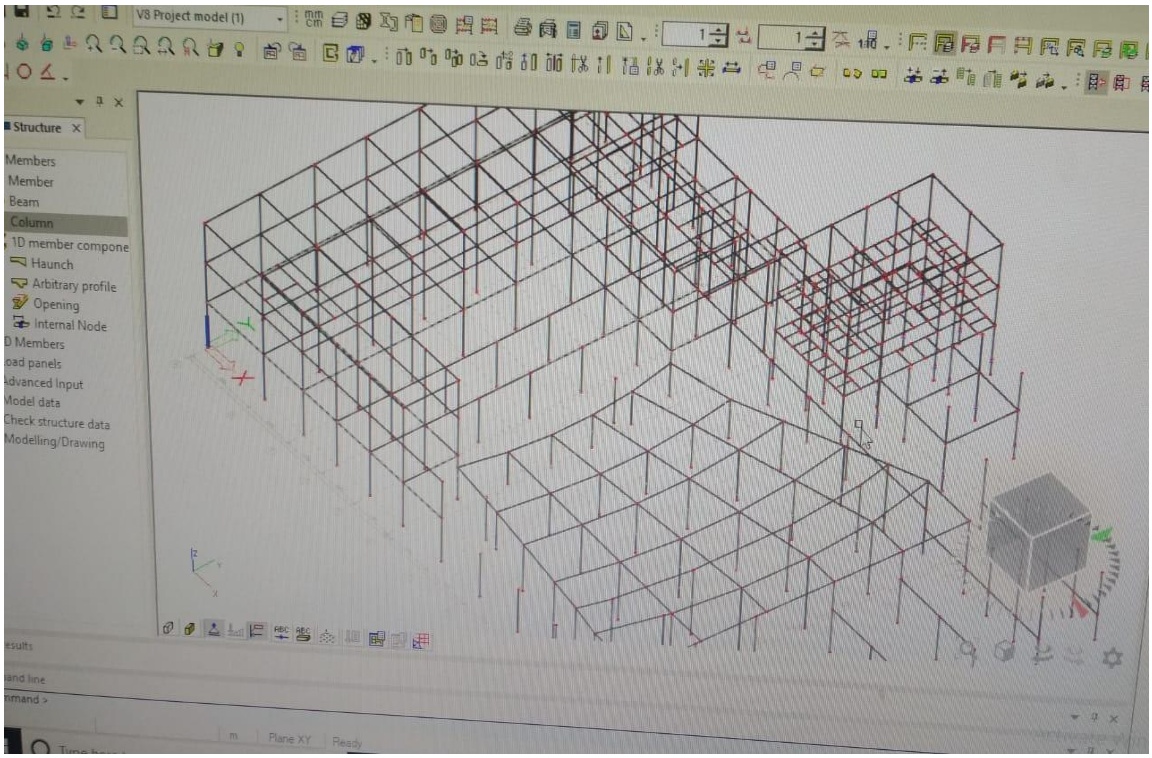
Following steps involve in methodology
1) Title of project
2) Research work for data
3) Drafting of plan in Auto CAD
4) Prepare model in STADD Pro according to plan
5) Analysis and design by STADD Pro.
6) Result Explanation

3.1 Modelling

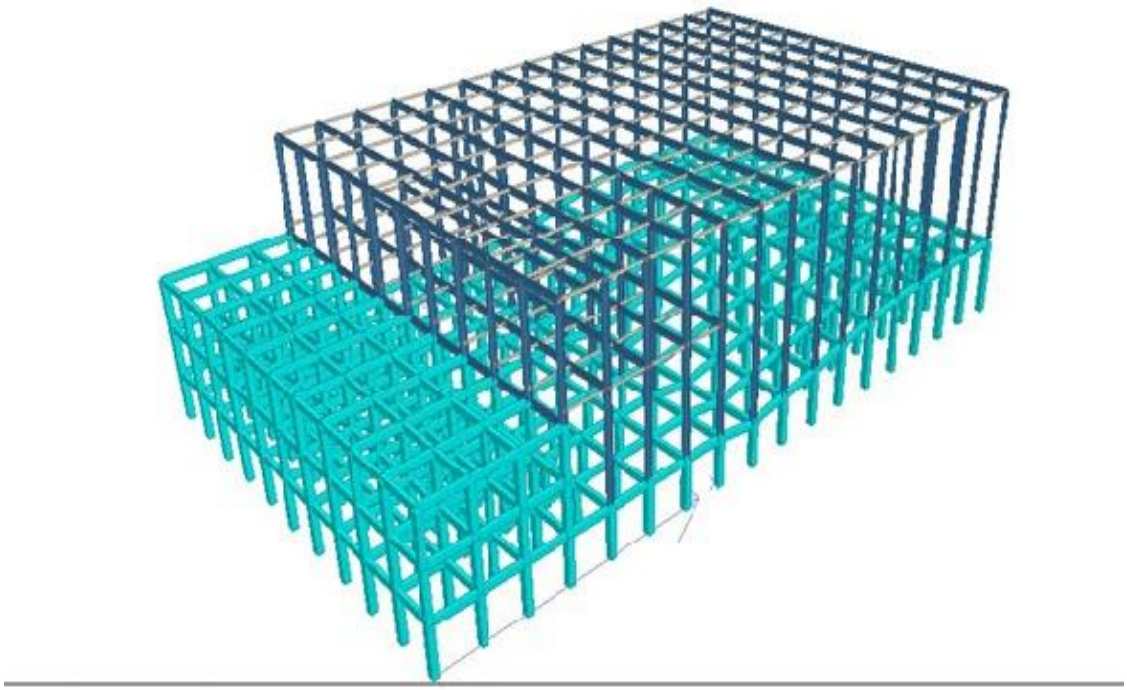
Design of auditorium building having capacity of 1000 people.



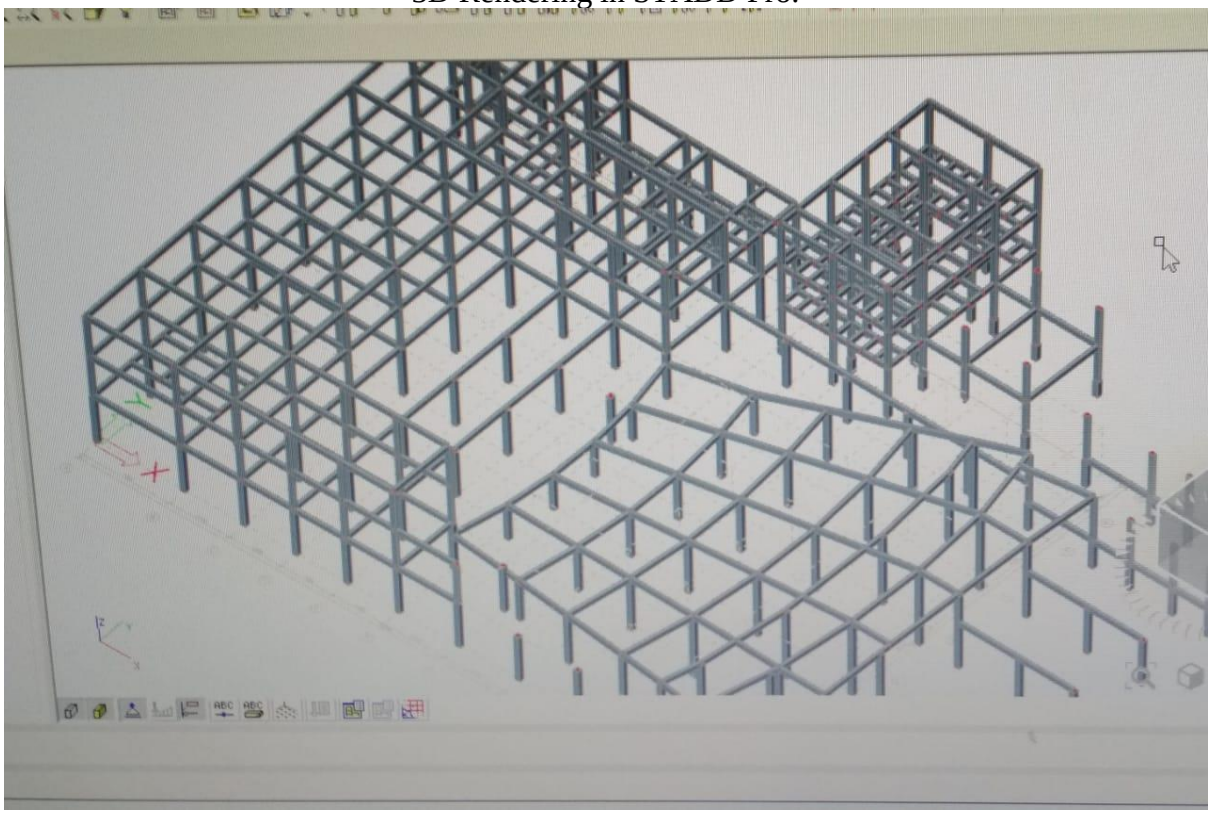
3D Modelling in STADD Pro.



3D Modelling in SCIA ENGINEER.



3D Rendering in STADD Pro.



3D Rendering in SCIA ENGINEER SOFTWARE

3.2 Loads

1. Dead load
2. Live load
3. Wind load
4. Load combination

3.2.1 Dead Loads

All permanent constructions of the structure form the dead loads. The dead load include the weights of walls, partitions, floor finishes, false ceilings, false floors, trusses, GI sheets and the other permanent constructions in the buildings. The dead load loads may be calculated from the dimensions of members and their unit weights.

3.2.2 Live load

Live load is produced by the intended use or occupancy of a building including the weight of movable partitions, distributed and concentrated loads, load due to impact and vibration. Live load do not include loads due to wind, seismic activity, snow, and loads imposed due to temperature changes to which the structure will be subjected to, creep and shrinkage of the structure, the differential settlements to which the structure may undergo.

3.2.3Wind Load

Wind is air in motion relative to the surface of the earth. The primary cause of wind is traced to earth's rotation and differences in terrestrial radiation. The radiation effects are primarily responsible for convection either upwards or downwards.

3.2.4 Design Wind Speed (V)

The basic wind speed for any site shall be obtained from the following aspects to get design wind velocity at any height for the chosen structure:
a) Risk level
b) Terrain roughness, height and size of structure
c) Local topography
Formula to calculate design wind speed:
V = Vb * K1 * K2 * K3
Vb = design wind speed at any height z in m/s;
K1= probability factor (risk coefficient)
K2 = terrain, height and structure size factor and
K3 = topography factor.

3.3 Analysis

Analysis of R.C.C structure and Steel structure members. It means to calculate the internal forces like axial compression bending movement, shear forces in the members. Members are to be designed under the action of given external loads.

3.4 Design

In design we have to achieve of an acceptable probability that structures being designed will perform satisfactory during their design lifespan.
Design of R.C.C beams, columns, steel sections in STADD Pro.

3.5 Geometric Parameters

Geometry of structure
The geometry of the structure as a whole is defined by the nodes at the ends of the various structural Members and each node has a unique number.

1) Plan Area: 70mX40m
2) Floor Height: 4m
3) Stage height: 9m
4) Wall Thickness: 230mm
5) Columns: 530mm X 530mm
6) Beams: 300mm X 600mm
7) Used grade of Concrete: M25
   Steel: Fy 415
8) Thickness of slab: 150mm
9) Seismic zone: III
10) Basic wind speed: 39 m/s
11) Floor finish: 1.0kN/m2
12) Live load at all floor: 5 KN/m3
13) Density of concrete: 25 KN/m3
14) Density of brick: 20 KN/m3
15) Density of steel: 7850 Kg/m3
16) Soil condition: Hard soil

4 Design

4.1 Design of Beams

There are two types of Beams i.e. Single Reinforced Beams and Double Reinforced Beams. Double reinforced beams are reinforced under compression tension both sides. The necessities of steel of compression region arise due to two reasons. When depth of beam is restricted. The strength a**v**ailability singly reinforced beam is not sufficient. Size of Beam 300mm X 600mm.

Width of beam =300mm
Depth of beam = 600mm
Thickness of slab, Df = 0.15
Length of beam L = 4000mm
Results :-
Provide 5 no's of bars # 10 at the top face at support of span sections

Provide 5 no's of bars #10 at the bottom tension face at centre of span section.

Provide 10 mm bars @ 2 legged vertical stirrups at 200 mm c/c.

Design of Columns
A column is an element used mainly to support axial compressive loads and with a height of a least three times its lateral dimension.
Size of column is taken as 530mm X 530mm
Factored load Pu =319.35 Kn

Results :-
Breadth of column = 530 mm
Depth of column = 530 mm
Main reinforcement:-
Provide 8 no's of 12 mm bars
Lateral reinforcement:-

Provide 8 mm # 250 mm c/c as lateral ties.

Conclusion

1) The building was analysed & designed using STAAD Pro. The dimensions of column is 0.53*0.53 m & beam 0.3*0.6 m.
2) Actually beam design for long span construction should be prefer PT beams instead of RCC beam. Normally if we use PT beam is size should be reduce half of the depth of beam size. Here steel section used for long span beam and column for roof and auditorium hall
3) STAAD Pro give satisfactory results when checked with manual design.
4) Project work on same model designing in SCIA ENGINEER is still in progress. SCIA interface is simple, the work environment is organized and highly customizable, besides having a command tree in software that follows the logical order of design of project.

Reference

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